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(71) Applicant
General Motors Corporation
3044 West Grand Boulevard
Detroit
Michigan 48202
United States of America
(72) Inventors
William Frederick Dais
Antoni Joseph Malarz
William Alfred Mueller
(74) Agents
J N B Breakwell

(54) **Forming combination flex-plate and gear members**

(57) An integral flex-plate and gear member is formed from a thin metal disc 10 by upsetting the outer periphery of the disc to form a flange on which gear teeth are then formed. Portions of the central area of the disc are removed so that a flexible hub portion is produced. The upsetting step is performed while the disc is heated and its edge is supported by rollers.

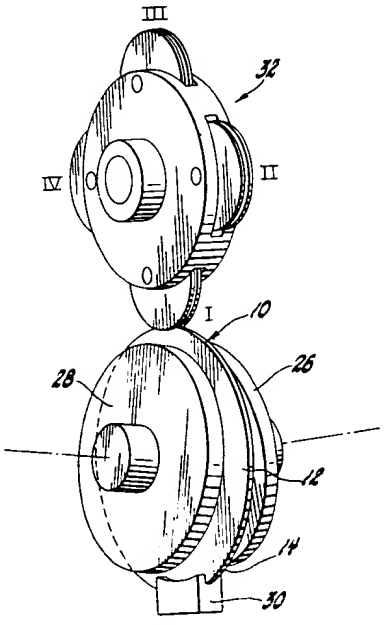

Fig.2

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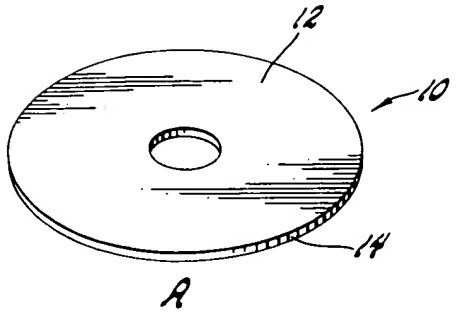

Fig. 1

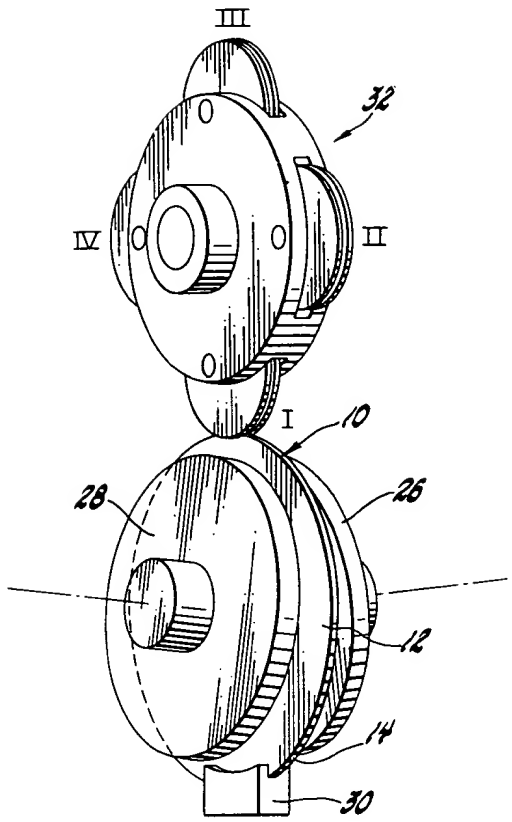

Fig. 2

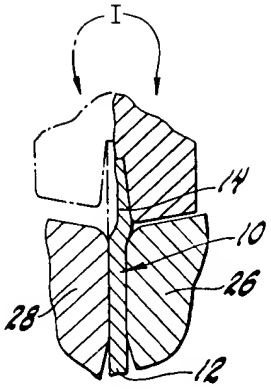

Fig. 2a

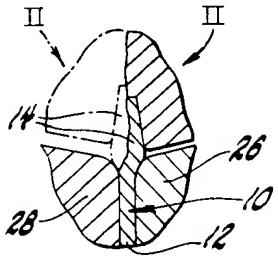

Fig. 2b

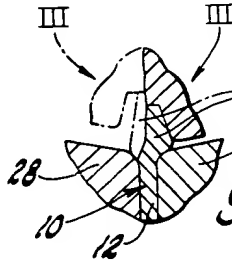

Fig. 2c

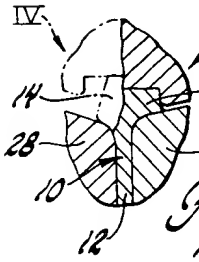

Fig. 2d

SPECIFICATION

Forming combination flex-plate and gear members

This invention relates to forming combination flex-plate and gear members.

A flex-plate secured between an engine crankshaft and a torque converter input of an automatic transmission accommodates slight misalignments which occur between the respective parts. A ring gear secured to the outer periphery of the flex-plate provides a starter gear for the engine.

It has been the common practice to make combination flex-plate and ring gear members by stamping the flex-plate from a sheet metal disc and then welding on a ring gear formed from rectangular bar stock which has been rolled and welded in a ring, with the gear teeth being subsequently formed thereon. Such prior-art procedure requiring manufacture from two separate pieces involves excessive handling during the manufacturing process.

By the present invention there is provided a method of forming a combination flex-plate and gear member from a flat thin metal disc, comprising rotating the disc about the central axis thereof, supporting the disc for a small arcuate distance on both sides adjacent the outer periphery of the disc with a pair of support rollers, heating the outer periphery of the disc during rotation, deforming the outer periphery of the disc radially inwardly towards the support rollers during the rotation and heating of the disc to form a flanged outer periphery which extends axially outwardly from both sides of the disc, forming gear teeth in the outer surface of the flanged outer periphery of the disc, and removing portions of the disc to form apertures therein so that a flexible hub portion is produced radially inwardly of the flanged outer periphery of the disc.

Conveniently in this method the disc is supported simultaneously on both axial sides for a small arcuate distance, is heated for a small arcuate distance, and is deformed radially inwardly adjacent the support position by upset rolling to form the flange on the outer periphery of the disc, with the teeth being formed in the flange by extruding, and the apertures being formed in the central portion of the disc by piercing to produce the flexible hub portion.

In the accompanying drawing:

Figure 1 is a perspective view illustrating successive shapes imparted to a sheet metal disc in a method in accordance with the present invention;

Figure 2 is a diagrammatic representation of flange-forming mechanism; and

Figures 2a to 2d are cross-sectional views illustrating successive stages of flange-forming using the mechanism of Fig. 2.

In the drawing, Fig. 1A shows an annular flat metal disc 10 having a flat central portion 12 and an outer periphery 14. In Fig. 1B, the disc 10 has had the outer periphery thereof deformed into a flanged portion 14*a*. In Fig. 1C, a plurality of gear teeth 16 have been formed in the flanged portion 14*a* of the metal disc 10.

These gear teeth 16 may be formed in a number of ways, such as by extruding.

In Fig. 1D, the flat central portion 12 has been indented to form a plurality of lug portions 18 and a central crankshaft mounting portion (hub) 20. The central portion 12 has also been pierced at a plurality of locations 22 to remove material therefrom, thus forming a flexible hub portion between the flanged portions 14*a* and the crankshaft mounting portion 20. The lug portions 18 each have an aperture 24 formed therein to permit the disc 10 to be secured to a torque converter in known manner. The removal of material and the indenting as shown in Fig. 1D may be accomplished either in a single piercing operation or in a plurality of operations.

In Fig. 2, the disc 10 is shown as being supported between two rollers 26 and 28 which contact the disc 10 for a small arcuate distance radially inwardly from the outer periphery 14. The disc 10 is adapted to be rotated such that the outer periphery 14 will be continuously passed through an inducation heating element 30 which is disposed substantially diametrically opposite the position at which the support rollers 26 and 28 abut the disc 10. A carousel 32 has rotatably supported therein a plurality of rolling dies designated I, II, III and IV, and is movable towards the centre of the disc 10 such that any selected one of the rolling dies I to IV can be progressively brought into contact with the outer periphery 14 of the disc 10.

As seen in Fig. 2*a*, the die I, as it progresses radially inwardly relative to the disc 10, causes the outer periphery 14 to bulge. The left-hand side of Fig. 2*a* shows the position of the die I prior to inward radial movement, whereas the right-hand side of Fig. 2*a* shows the position of the die I at the end of its radial inward movement, when it is in contact with the rollers 26 and 28. When the die I has completed its radially inward travel, the carousel 32 is progressed so that the die II comes into abutment with the outer periphery 14. The carousel 32 is then progressed radially inwardly towards the disc 10 so as to further deform the outer periphery 14 of the disc 10. The left-hand side of Fig. 2*b* shows the position of the die II prior to movement of the carousel 32, whereas the right-hand portion of Fig. 2*b* shows the effect of full movement of the carousel 32 with corresponding deformation of the outer periphery 14 of the disc 10.

Figs. 2*c* and 2*d* show further progressive deformation of the outer periphery 14 of the disc 10. The right-hand side of Fig. 2*d* shows a completed flanged portion 14*a* formed on the outer periphery of the disc 10. It is this flanged portion that has the gear teeth 16 formed therein. The induction heater 30 maintains the outer surface of the disc 10 at a temperature in the range of 704° to 760°C (1300° to 1400°F), thus reducing the forces necessary for rolling the flanged portion of the disc 10.

When the disc 10 has reached its final shape as shown in Fig. 1D, it may be heat-treated and balanced as desired.

The above description will make clear that the method of the present invention has the potential for reducing the material-handling problems previously associated with the assembly of two-piece flex-plate and gear members. The present method involves the handling of only a thin metal disc workpiece from start to finish, and there is no requirement to fixture a flex-plate and a ring gear so that they can be joined together by welding. The thickness of the flanged portion 14*a* can be controlled by the design of the rolling dies I to IV, so allowing the sizes of the gear teeth that are formed therein to be readily accommodated.

CLAIMS

1. A method of forming a combination flex-plate and gear member from a flat thin metal disc, comprising rotating the disc about the central axis thereof, supporting the disc for a small arcuate distance on both sides adjacent the outer periphery of the disc with a pair of support rollers, heating the outer periphery of the disc during rotation, deforming the outer periphery of the disc radially inwardly towards the support rollers during the rotation and heating of the disc to form a flanged outer periphery which extends axially outwardly from both sides of the disc, forming gear teeth in the outer surface of the flanged outer periphery of the disc, and removing portions of the disc to form apertures therein so that a flexible hub portion is produced radially inwardly of the flanged outer periphery of the disc.

2. A method of forming a combination flex-plate and gear member, substantially as hereinbefore particularly described and as shown in the accompanying drawing.

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